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(19)

(54) TITANIUM ALLOY FOR DEFORMATION IN THE COLD STATE

(71) We, UGINE KUHLMANN, a French body Corporate, of 10, Rue du General Foy, Paris 8e, France, do hereby declare the invention for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a weldable titanium alloy which is deformable in the cold state, and to its uses including articles made therefrom such as bolts and rivets.

In aeronautical craft and spacecraft lightweight metal equipment, the connecting elements, such as bolts and rivets, are of steel or Monel metal, which substantially increases the weight of the craft (Monel is a Registered Trade Mark).

The main object of this invention is to provide an improved alloy which can be used in making articles such as bolts and rivets which are light in weight.

According to the present invention there is provided a titanium alloy in the annealed condition, comprising by weight 0.1 to 2% of Cu and having proportions by weight of impurities C $\leqslant$ 0.1%, $N_2 \leqslant$ 0.05%, $H_2 \leqslant$ 0.0125%, $O_2 \leqslant$ 0.1%, Fe $\leqslant$ 0.05, and other elements not more than 0.05% each, the remainder being titanium.

Preferably the oxygen content of the alloy of the invention is 0.070 to 0.090% by weight.

The mechanical properties of this annealed alloy are linked to its Cu content and with the low proportions imposed for the impurities, in particular oxygen. This alloy is employed for example in the production of plates which can be stamped in the cold state, fine wires, tubes used for bending, and welded assemblies, and it is particularly appropriate for the producing rivets since it has the requisite characteristics such as a shearing strength, at ambient temperature, of at least 34 hbar, a Vickers hardness of at most 170, under 10 kgs, and a conformability in the cold state which allows fitting and striking with conventional pneumatic tools.

By way of example, two ingots of titanium alloy having the following corresponding analyses were produced in a vacuum furnace having a consumable electrode:

	A	B
Cu	0.60%	1.05%
O_2	0.080%	0.083%
C	0.012%	0.012%
N_2	0.012%	0.013%
Fe	0.028%	0.026%
H_2	21 ppm	17 ppm
Ti	the rest	the rest

[Price 25p]

5: .104 .108

183.96 = 219.4

and rivet wire was produced therefrom with a diameter of 5.5 mms which, after annealing for 1 hour at 800°C with cooling within the furnace, was exposed to tests for tensile strength, shearing strength, hardness and behaviour during squashing. This last test used for rivets (specification OMO 41 of Sud Aviation), consists in placing a piece of wire in the socket of a female die whilst leaving a projecting length equal to the diameter, squashing it to a given thickness and noting the appearance of the metal. The test is satisfactory if no crack or fissure is detectable at the enlargement 5.

The same tests were carried out with wire or Monel metal (alloy of Ni containing 31% of Cu) and of non-alloyed titanium UT 50, of a diameter of 4 mms. The results of these tests are given in the following table:

Material	State	d (mm)	R (hbar)	A% — 5d Σ%	Shearing strength (hbar)	ΔV_{10}	Squashing test
Monel	annealed	4	55.6	55 75	35.7	118	good
UT 50	annealed	4	56.4	30 40	40.4	188.6	good
A	annealed	5.5	38.1	32 70	35.3	136	good
B	annealed	4.5	42.8	35 66	38.5	137	good

It is noted that the mechanical characteristics of the annealed alloy of the invention are equivalent to those of Monel metal, in respect of shearing strength, and thus allow a saving of the order of 45% compared with the weight of the rivets of Monel metal, for identical geometrical shapes.

WHAT WE CLAIM IS:—

1. A titanium alloy in the annealed condition containing by weight 0.1 to 2% of Cu and having proportions by weight of impurities C $\leqslant$ 0.1%, $N_2 \leqslant$ 0.05%, $H_2 \leqslant$ 0.0125%, $O_2 \leqslant$ 0.1%, Fe $\leqslant$ 0.05, and other elements not more than 0.05% each, the remainder being titanium.

2. A titanium alloy according to Claim 1 wherein the oxygen is 0.070 to 0.090% by weight.

3. A titanium alloy according to Claim 1 substantially as herein described.

4. Rivets made of the titanium alloy according to any of Claims 1 to 3.

5. Plates for cold-stamping made of alloy according to any of Claims 1 to 3.

6. Fine wire made of alloy according to any of Claims 1 to 3.

7. Tubes made of alloy according to any of Claims 1 to 3.

8. Welded assemblies made of alloy according to any of Claims 1 to 3.

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